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HYDROFOIL

Filed March 30, 1960

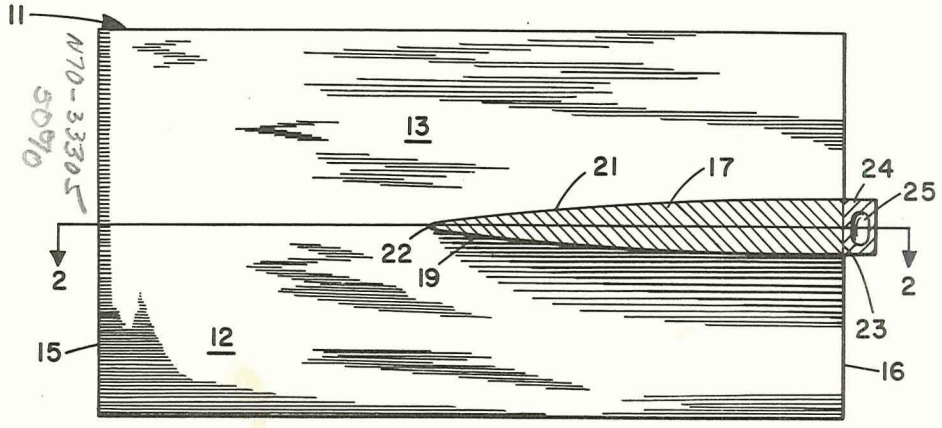

FIG. 1

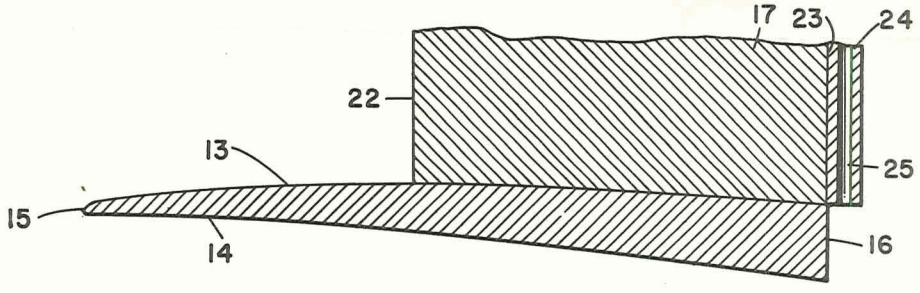

FIG. 2

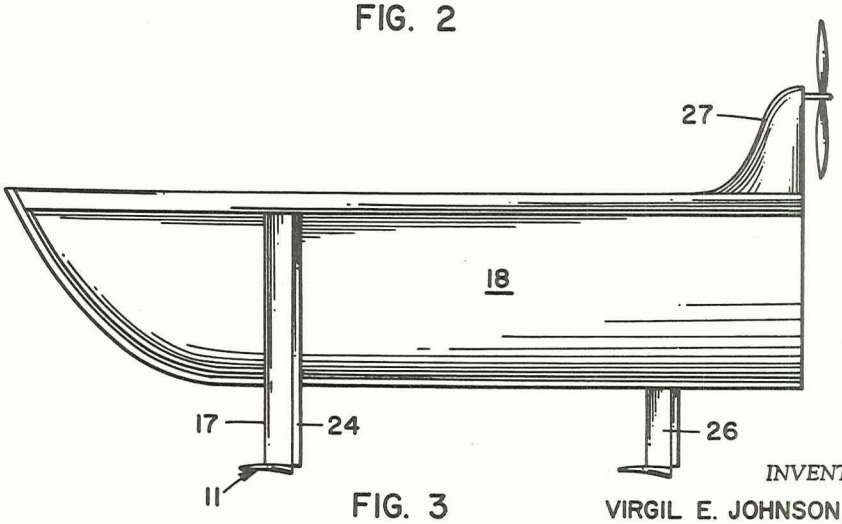

FIG. 3

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HYDROFOIL

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1 Claim. (Cl. 114—66.5)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates generally to a hydrofoil, and more particularly to a high speed hydrofoil.

Heretofore, various hydrofoil configurations have been proposed for operating in the high speed range of about one hundred knots. One such proposed configuration is a supercavitating hydrofoil having a body portion with a triangular or wedge shaped cross section, a thin sharp leading edge, and a blunt trailing edge. This supercavitating hydrofoil operates reasonably well in the high speed ranges; however, a fixed water vapor bubble forms during operation across the upper surface thereof and extends rearwardly to a point well beyond the trailing edge which imparts drag to the hydrofoil with a loss of operating efficiency. In order to reduce drag, the leading edge is made very thin and thereby is extremely susceptible to bending and breaking in operation. Another proposed configuration for high speed operation is the conventional subsonic airfoil like hydrofoil. This hydrofoil is designed to operate with both surfaces fully wetted so that a vapor cavity does not form along the upper surface thereof. In order to prevent the formation of a vapor cavity, the airfoil-like hydrofoil is made extremely thin and during operation it likewise is subject to deformation and breakage. A hydrofoil is therefore desirable which is capable of efficient operation at high speeds and which has sufficient structural strength to resist deformation during operation.

Accordingly, it is an object of the present invention to provide a new and improved hydrofoil.

Another object of the instant invention is to provide a new and improved high speed hydrofoil.

A further object of this invention is to provide a new and improved hydrofoil capable of operating in the one hundred knot speed range.

A still further object of the instant invention is to provide a new and improved non-supercavitating hydrofoil.

Another and still further object of the present invention is to provide a new and improved hydrofoil having a good operating efficiency in the high speed ranges.

One still further object of the instant invention is to provide a new and improved structurally desirable hydrofoil having a good lift-drag ratio for high speed operation.

Generally speaking, the foregoing objects as well as others are accomplished in accordance with this invention by providing a high speed non-supercavitating hydrofoil having a wedge shaped cross section with a convex top surface, a linear-concave bottom surface, a rounded leading edge, and a blunt trailing edge.

A more complete understanding of the invention and many of the attendant advantages thereof will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

FIG. 1 is a top view of the hydrofoil and supporting strut of the invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1; and,

FIG. 3 is a side view of the hydrofoil of FIG. 1 positioned on a water craft.

Referring now to the drawing wherein like reference numerals designate identical or corresponding parts throughout the several views, and more particularly to FIG. 1 whereon the hydrofoil, generally indicated by the reference numeral **11** is shown as consisting of a rectangular plate **12** having the particular cross-sectional shape, as shown on FIG. 2. Plate **12** has a wedge shaped cross section with a convex top surface **13** and a linear-concave bottom surface **14** and a rounded leading edge **15**. Wedge shaped plate **12** has an increasing thickness distribution between top surface **13** and bottom surface **14** terminating in a blunt trailing edge **16**.

The preferred shape of plate **12** has been determined by using an open thickness distribution such, for example, as a wedge or parabola with a camber which has previously been determined theoretically to give uniform pressure distributions by methods known in the art. Plate **12** can be produced from any material having a strength sufficient to withstand loads such as are encountered in lifting a hull of a water craft from the water surface and maintaining it in this position for extended periods of time. The material should also be able to withstand the deleterious effects of water as the hydrofoils may be submerged therein for long periods of time. One such suitable material has been found to be highly polished stainless steel.

Strut **17** connects hydrofoil **11** to the supporting water craft **18**. Strut **17** likewise has a preferably parabolic cross-section. Strut **17** has symmetrical convex side surfaces **19** and **21** which are anteriorly connected by a rounded leading edge **22** and terminate in a blunt trailing edge **23**. Strut **17** is vertically connected to top surface **13** of plate **12**, as shown on FIG. 1.

A rectangular shaped pressure ventilator **24** having a vertical bore **25** is affixed to trailing edge **23** of strut **17**. Ventilator **24** extends upwardly from top surface **13** of plate **12** to a point above the water surface.

In operation lifting hydrofoils **11** are positioned on each side of water craft **18**, as shown on FIG. 3. A stabilizing hydrofoil **26** is positioned centrally on craft **18** and at an opposite end from lifting hydrofoils **11**. Hydrofoil **26** can be the same as hydrofoil **11** or any conventional hydrofoil. A propulsion means **27** is provided to drive craft **18** through the water and the passage of water over hydrofoils **11** creates a uniform negative pressure distribution over the hydrous top surface **13** of plate **12** and a positive pressure distribution over bottom surface **14**. This pressure distribution exerts an upward thrust on struts **13** and lifts craft **18** above the water surface. As hydrofoil **11** passes through the water at relatively slower speeds, a fixed water vapor bubble forms along blunt trailing edge **16** resulting in the creation of a base drag equal to the product of the base area and the vapor pressure. This vapor cavity is vented to approach the ambient free stream pressure by air passing down bore **25** by self entrainment as hydrofoil **11** travels through the water. Ventilating hydrofoil **11** in this manner eliminates strut and hydrofoil base drag thereby allowing hydrofoil **11** to operate efficiently.

Obviously numerous modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

A non-supercavitating hydrofoil capable of submerged high speed operation comprising a body member wedge

shaped in cross section having a convex top surface, a linear concave bottom surface, a rounded leading edge and a blunt trailing edge; a strut affixed to said body member top surface, said strut having parabolic convex symmetrical sides and a blunt trailing edge; and a pressure ventilator affixed to said blunt trailing edge of said strut, said pressure ventilator having a bore therethrough, said pressure ventilator extending downwardly from a source of atmospheric pressure and terminating at said top surface of said body member adjacent said blunt trailing edge of said body member, thereby being adapted to convey a gaseous medium to said blunt trailing edge of said body member for preventing supercavitating operation.

References Cited in the file of this patent

UNITED STATES PATENTS

1,831,339	Brush	Nov. 10, 1931
2,408,788	Ludington et al.	Oct. 8, 1946
2,562,227	Zobel	July 31, 1951
2,890,672	Boericke	June 16, 1959

FOREIGN PATENTS

34,042	Netherlands	Nov. 15, 1934
715,880	Great Britain	Sept. 22, 1954
549,266	Italy	Oct. 9, 1956